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Radioisotopic calibration of the Guadalupian (middle Permian) series: Review and updates

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ABSTRACT

Four high-precision U-Pb CA-IDTIMS dates for the Roadian (lower Guadalupian) of 274.0 ± 0.12 and 273.1 ± 0.1 Ma and for the Wuchiapingian (lower Lopingian) of 260.16 ± 0.39 and 258.14 ± 0.20 Ma were obtained from Permian tuff beds in the periphery of the Okhotsk Massif, N-E Russia. The beds are well constrained within the local lithostratigraphic and regional biostratigraphic framework. Besides regional bivalves and brachiopod faunas, the ammonoid *Sverdrupites harkeri* occurs close to the recovered Roadian tuffs. This ammonoid provides direct correlation of the tuffs with the Kazanian Stage on the Russian Platform and the Roadian Stage in the Canadian Arctic, where the conodont index species of the Roadian Stage *Jinogondolella nankingensis gracilis* and *Sverdrupites harkeri* and other Roadian ammonoids are documented from the Assistant Formation. Our review of the Kungurian-Roadian-Wordian successions in the main well-studied regions suggests that the base of the Roadian Stage should be extended down to approximately 277 Ma and the Roadian-Wordian boundary should be placed at approximately 271 Ma. The new calibration of the Roadian Stage reduces the duration of the enormously long Kungurian Stage from about 10 Myr approximately to 6.0–6.5 Myr. If the proposed calibration is correct, the duration of Guadalupian Series would be almost twice as great as in the previous estimates. Our results also suggest a possible correlation of the P3 alpine glacial event in the Eastern Australia with the Wordian and possible uppermost Roadian Stages. This P3 event corresponds with the disappearance of ammonoids and conodonts in the upper Roadian and Wordian in high-latitudes regions, i.e. N-E Russia, Russian and Canadian Arctic and Australia, perhaps due to extreme cooling of these areas. The new radioisotopic ages in the Okhotsk Massif and surrounding regions improve the numerical calibration of the palynological zonation in the Eastern Australia and provide a direct correlation of the regional biostratigraphic brachiopod and bivalve zonation of N-E Russia with the International Geologic Time Scale. This zonation becomes a solid and reliable regional correlation tool within the vast territory from Taymyr and East Siberia to entire N-E Russia and Transbaikalia.

1. Introduction

The radioisotopic calibration of the International Geologic Time Scale (IGTS) is an important task that is still far from being complete. It is particularly true for parts of the Paleozoic and Mesozoic Erathems of the GTS (International Chronostratigraphic Chart, www.stratigraphy.org, 2017; Gradstein et al., 2012). The Permian time scale is the demonstrative example: while the lower Cisuralian Series (Asselian, Sakmarian and lower Artinskian Stages) and upper Lopingian Series (Wuchiapingian and Changhsingian) are calibrated quite well (Davydov et al., 2012; Henderson et al., 2012), the part of the Permian starting from the middle Artinskian up to about the lower third of the Wuchiapingian possesses very few U-Pb ages and requires re-study (Bowring et al., 1998).

The Guadalupian International Time Scale was established in the Guadalupe Mountains, Texas (Henderson et al., 2012). Although the final step of the stage validation, i.e., publication in Episodes, has not been achieved, the formal acceptance and ratification of the Guadalupian Stages occurred back in 2001 (Henderson, 2001). The GSSP for the base of the Roadian Stage, Guadalupian Series, middle Permian, is in Stratotype Canyon, Guadalupe Mountains national Park, Texas, USA. The marker horizon is the first evolutionary appearance of the conodont

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